EARTH ORBITER -1
Level II Configuration Control Board
CCR Distribution

EO-1 CCB Chairman: Pete Spidaliere

EO-1 CCR No.: 0004
CCR TITLE: Baseline Draft Issue of EO-1 XPAA ICD-047
Date Issued: December 18, 1997
Due Date: January 19, 1998
CR Status: Routine

Distribution List:

K.Perko/GSFC
M.Perry/SWALES
M.Cully/GSFC
M.Jurotich/GSFC
P.Spidaliere/GSFC
K.Fielhauer/LITTON
F.Pellerano/GSFC
G.Andrew/LITTON
M.Kelley/GSFC
B.Smith/GSFC
N.Speciale/GSFC

EO-1 Configuration Manager: Steve Schneider/CSC/GSFC
sschneider@hst.nasa.gov
301-286-3457

NEW MILLENNIUM PROJECT CONFIGURATION CHANGE REQUEST

PROGRAM EO-1

CCR NO. 0004

DATE INITIATED 12/18/97

EFFECTIVITY

ITEM: ~~XPAA~~

S / N

ITEM:

S / N

ITEM:

S / N

TITLE BASELINE EO-1 X-BAND PHASED ARRAY ANTENNA SYSTEM

ORIGINATOR Boeing Aerospace

ORIGINATOR'S CHG. NO. ICD-047

SPONSOR/CODE K. Perko/NMP-XPAA Lead **PHONE** x6375

CHANGE CLASS

	I	II
PRELIMINARY	☐	☐
FORMAL	☐	☐

TYPE OF CHANGE

MILESTONE	☐	INTERFACE	☒	SOFTWARE	☐
DOCUMENT	☒	POWER	☐	OTHER	☐
COST	☐	WEIGHT	☐		☐

DOCUMENTS OR SOFTWARE AFFECTED

EO-1 ICD-047

PROBLEM

The attached draft version of EO1-ICD-047, Earth Orbiter -1 (EO-1) X-Band Phased Array Antenna (XPAA) Interface Control Document (ICD) requires baselining. The document defines the functional, physical and electrical characteristics of the XPAA that impacts the EO-1 spacecraft on which it will be installed.

PROPOSED SOLUTION

Approve the attached draft version of EO-1 ICD-047, XPAA ICD, by the EO-1 Level II Configuration Control Board (CCB). This draft issue will be formally released after CCB approval. Future changes will be initiated by submittal of Configuration Change Requests (CCRs) and Preliminary Interface Revision Notices (PIRNs) for CCB approval. This document is maintained by the EO-1 Configuration Management Office (CMO).

BOARD ACTION

APPROVE	☐
APPROVE WITH CHANGE	☐
DISAPPROVE	☐
WITHDRAW	☐

APPROVAL LEVEL REQUIRED

LEVEL I HQS	☐
LEVEL II GSFC	☒
LEVEL III	☐

CRITICALITY LEVEL

EMERGENCY	☐
URGENT	☐
ROUTINE	☒

PROCUREMENT CHANGE ORDER CLASSIFICATION

ROUTINE	URGENT	EMERGENCY ☐
OPTION 1 ☐	OPTION 1 ☐	
OPTION 2 ☐	OPTION 2 ☐	

COMMENTS

CHAIRPERSON _____ **DATE** _____

EO-1 ICD-47
Draft Issue
December 18, 1997

EO-1
X-BAND PHASED ARRAY ANTENNA SYSTEM INTERFACE CONTROL DOCUMENT (ICD)

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

EO-1 ICD-47
Draft Issue
December 18, 1997

Interface Control Document

for the

New Millennium Project
Earth Orbiter-1 (EO-1)
X-Band Phased Array Antenna System

18 December 1997

NASA Goddard Space Flight Center

Summary:

The Interface Control Document for the New Millennium Project X-Band Phased Array Antenna (XPAA) provides a definition of all functional, physical, and electrical characteristics of the XPAA that impact the Earth Observer-1 (EO-1) spacecraft on which it will be installed. The interface definition in the ICD is designed to ensure that equipment and software delivered by The Boeing Company will operate properly when installed on the EO-1 spacecraft, will meet the requirements for which it was designed, and will not adversely affect any aspect of the EO-1 spacecraft operations.

TABLE OF CONTENTS

Page

1. GENERAL…… 6
1.1 Scope and Purpose…….. 6
1.2 Antenna Subsystem Overview……. 6
1.3 Applicable Documents…….. 6

2. SYSTEM INTERCONNECT DIAGRAM…… 8

3. MECHANICAL INTERFACE…….. 9
3.1 General…… 9
3.2 Antenna Envelope…… 9
3.3 Antenna Footprint and Fastener Requirements…… 9
3.4 Antenna Mounting Requirements …… 10
3.5 Antenna Mass and Center of Mass…… 10

4. THERMAL INTERFACE…….. 11

5. ELECTRICAL INTERFACE…… 12
5.1. General……12
5.2. Electrical Block Diagrams……..
12
5.3.RF Interface……13
5.4.DC Power Requirements……..… 14
5.5. Communications Interface…… 14
5.6. Cabling interface……15
5.7.EMI/RFI…… 15
5.8. List of Connectors…….. 15

6. SOFTWARE INTERFACE…….. 17

7. VALIDATION INTERFACE…… 18
7.1 List of Validation Functions…… 18
7.2 Implementation of Validation Functions……..18
7.2.1. Array Voltages……18
7.2.2. Array Currents…… 18
7.2.3. Temperature Measurements……19
7.2.4. Phase Bit Verification……19
7.3 Range of Validation Functions…… 19
7.4 Telemetry Frequency…… 20

LIST OF FIGURES

		Page
Figure 2.1	System Interface Diagram……	8
Figure 3.2.1	Physical Envelope of the Antenna……	9
Figure 3.3.1	Antenna Footprint……	10
Figure 5.2.1	RSN Electrical block diagram……	12
Figure 5.2.2	Array Block Diagram……	13
Figure 5.3.1	RF Allocations……	14
Figure 7.2.1	Antenna Current and Voltage Measurement Network……..	18
Figure 7.2.3	Temperature Measurement Interface……..	19

LIST OF TABLES

Table 5.7.1	Antenna Connections……	15
Table 5.7.2	Connector J6 Pin-Outs……..	15
Table 5.7.3	Connector J7 Pin-Outs……..	16
Table 5.7.4	Connector J8 Pin-Outs……..	16
Table 7.3	Measured Parameter Values and Ranges……	20

ACRONYMS AND ABREVIATIONS

ASIC	Application Specific Integrated Circuit
CMOS	Complementary Metal Oxide Semiconductor
DC	Direct Current
D&SG	Defense & Space Group (Boeing)
COTS	Commercial Off-The-Shelf
EO-1 S/C	Earth Observer-1 Spacecraft
EIRP	Effective Isotropically Radiated Power
ESN	Essential Services Node
ICD	Interface Control Document
LVPC	Low Voltage Power Supply
MCM	Multi-Chip Module
MMIC	Monolithic Microwave Integrated Circuit
NASA	National Aeronautics and Space Administration
NMP	New Millennium Project
RF	Radio Frequency
RSN	Remote Services Node
SOW	Statement of Work
SSO	Space Systems Operation (Litton Amecom)
V	Volts
XPAA	X-Band Phased Array Antenna
WARP	Wideband Advanced Recorder Processor

1. GENERAL

This ICD contains data and drawings required to define the interface characteristics of the X-Band Phased Array Antenna System that will be mechanically, functionally and electrically integrated with the Earth Observer-1 Spacecraft.

1.1. Scope and Purpose

The ICD will contain all software, hardware (mechanical), thermal, electrical power, RF signal, logic or control signal, telemetry signal, data signal and operational interfaces of the XPAA with the EO-1 spacecraft. Included are the ESN and RSN components.

1.2. Antenna Subsystem Overview

The X-Band phased array antenna comprises 64 active radiating elements each with an independent phase controller and power amplifier allowing electronic steering of the antenna beam. Element phases are calculated to point the beam at the commanded elevation and azimuth by an RSN provided by Litton Amecom. Telemetry and commands are transmitted to the antenna over a dual MIL-STD 1773 fiber optic data bus, and 8.225 GHz RF excitation is supplied by the WARP via a coaxial cable. The data rate is 105Mbps.

The advantage of an electronically steered antenna for small satellite applications, where platform stability is important, is that no reaction torque compensation is needed during a communications pass allowing the simultaneous acquisition of precision optical data.

1.3. Applicable Documents

a. **NASA Document 737-EO1-RSD-XPAA**, “Performance Specification and Design Requirements for the New Millennium Program Earth Observer-1, X-Band Phased Array Antenna”, released April 1, 1997

b. **NASA Document 737-EO1-SOW-XPAA**, “Statement of Work for the New Millennium Program Earth Observer-1, X-Band Phased Array Antenna”, released April 4, 1997

c. **Swales Aerospace, Inc. Internal Memo, "EO-1 X-Band Antenna Environmental Criteria**", George Hinshelwood to Mike Cully, EO-1 Project Manager/Swales Aerospace, released March 24, 1997, transmitted to Gary Miller, X-Band/Mechanical Lead/Boeing Company

d. **MIL-STD-461C,** Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference (Notice 1)

e. **MIL-STD-462,** Measurement of Electromagnetic Interference Characteristics

f. **MIL-STD-1773B,** Fiber Optics Mechanization of an Aircraft Internal Time-Division Command/Response Multiplex Data Bus

g. **NASA Document ICD-735-2827**, "Essential Services Node hardware Specification (Revision 2.0)"

h. **Litton Drawing No. 184622,** "Chassis Assembly, LWH-14-.050"

i. **Litton Document ICD-xxx-xxx**, "X-Band Exciter to Memory Interface Control Card"

j. **Swales Document XXX-XXX**, "Cable ICD"

2. SYSTEM INTERFACE DIAGRAM

An interconnect diagram is provided to show the system level interconnects for RF excitation, fiber optic control and telemetry signals, and DC power. A service connector for software loading, and a test connector for testing during integration are also shown. Electrical and signal characteristics, and cabling are further defined in Section 5

Figure 2.1 shows the system interface connections between the antenna and the WARP, the fiber optic star coupler, and the 28 V power supply.

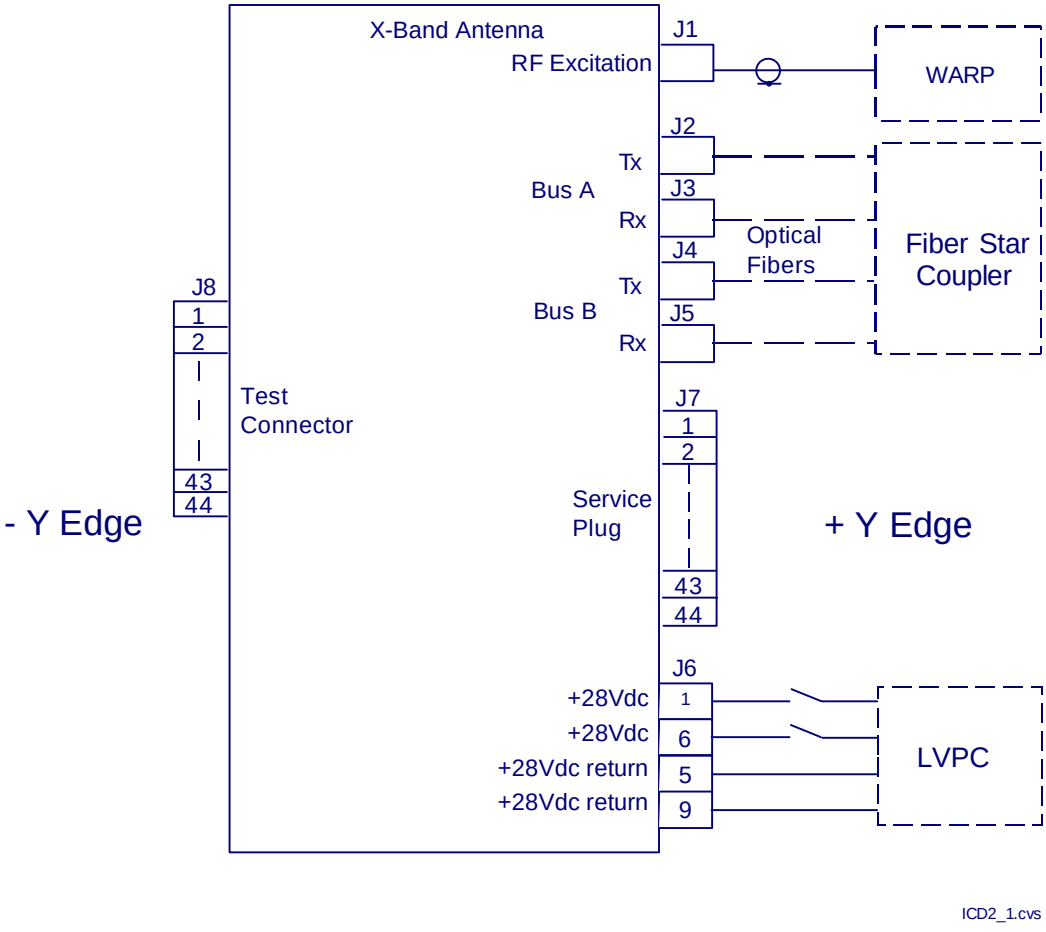


Figure 2.1 System Interface Diagram

3. MECHANICAL INTERFACE

3.1. General

The antenna enclosure is a two level structure. The 64 radiating elements and the high wattage dc to dc converters for the antenna 5V power are located on the upper level, and an RSN controller board is located on the lower level. The lower level of the enclosure is geometrically identical to one slot of the Litton Chassis (Litton drawing No. 184622) permitting the generic RSN board to be accommodated without any mechanical change to the basic RSN.

3.2. Antenna Envelope

Figure 3.2.1 shows the physical envelope of the antenna. The RF excitation input, the service connector, and the fiber optic connectors are located on the positive Y direction face, and the test connector on the negative Y direction face.

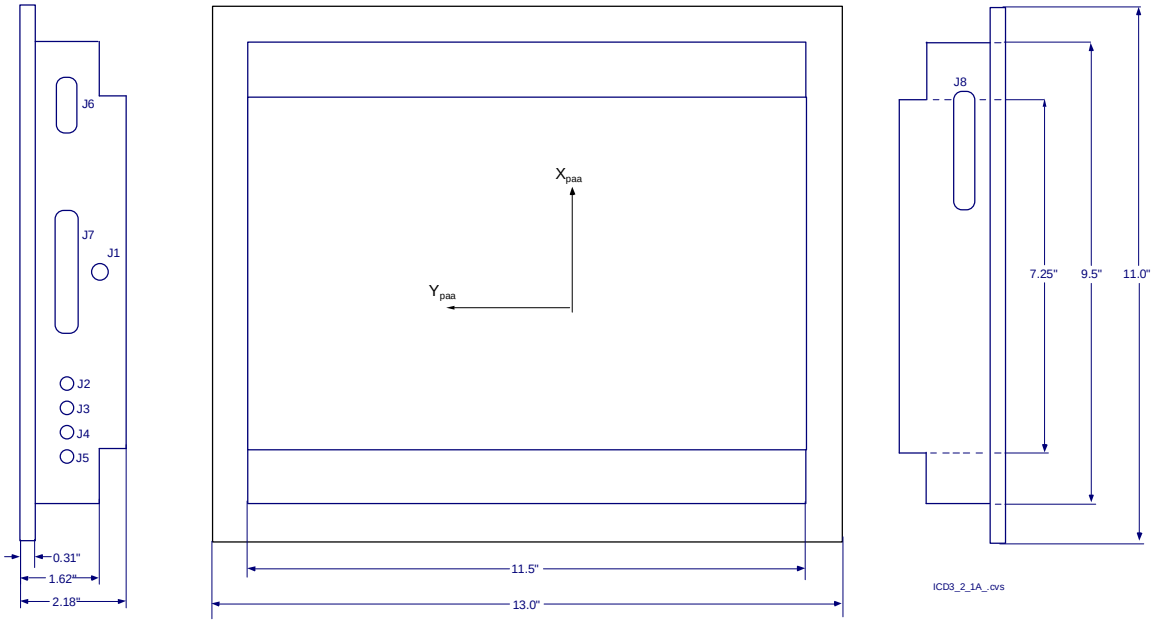


Figure 3.2.1 Physical Envelope of the Antenna

3.3. Antenna Footprint and Fastener Requirements

Figure 3.3.1 shows the mechanical footprint of the antenna. The antenna is secured to the mounting plate by 8 NES 1578 ¼-28 threaded fasteners.

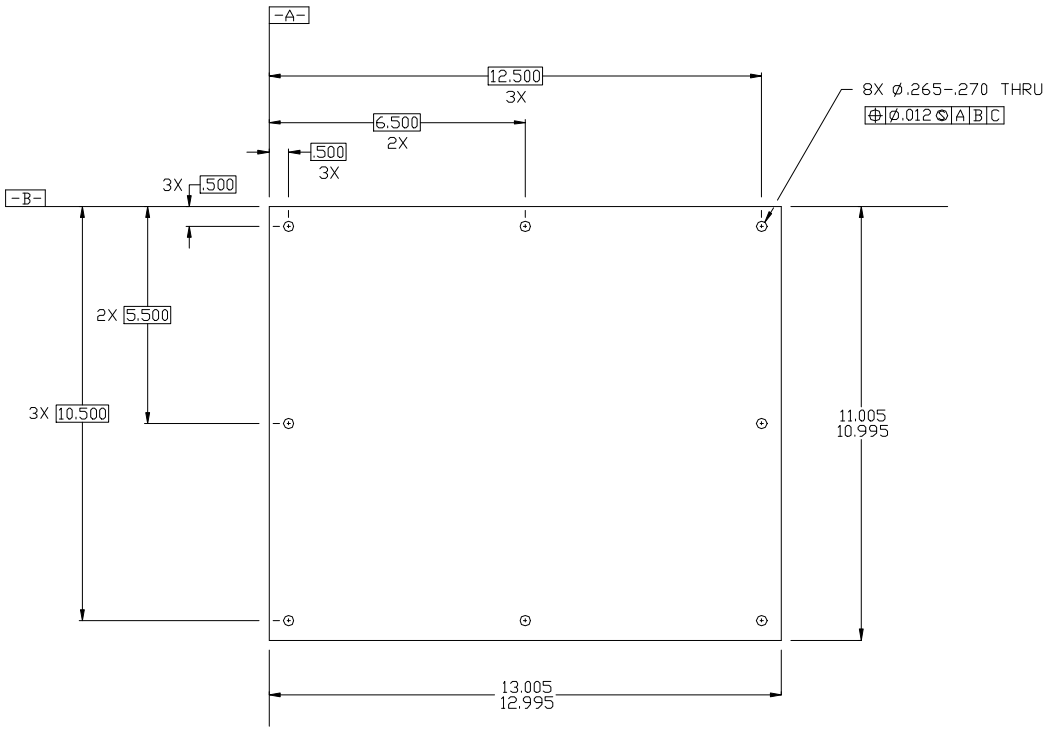


Figure 3.3.1 Antenna Footprint

3.4. Antenna Mounting Requirements

A sheet of xxx Co-Therm should be placed between the antenna and the mounting plate, and the ¼-28 fasteners torqued to 91 ins-lbs.

3.5. Antenna Mass and Center of Mass

TBD

4. THERMAL INTERFACE

Power dissipated by the antenna will range from 40 to 56 W depending upon the final MMIC configuration. Radiated heat input or loss during operation and transient behavior are TBD.

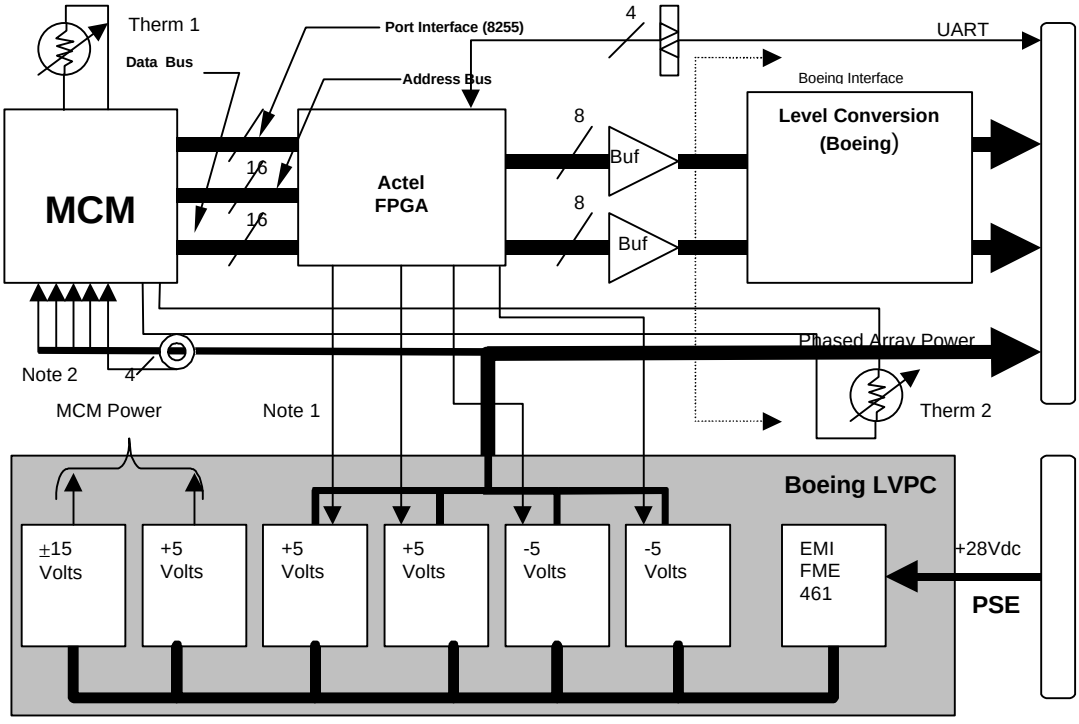
5. ELECTRICAL INTERFACE

5.1. General

The antenna comprises a 64 element array, and an RSN board. With the exception of the antenna modules, all electrical and electronic components are mounted on the RSN board.

5.2. Electrical Block Diagrams

Figure 5.2.1 shows the RSN electrical block diagram.



Note 1: Discrete provides TTL compatible power supply turn on/off
Note 2: Voltages and current shall be monitored in a “standard fashion”

Figure 5.2.1 RSN Electrical Block Diagram

Support electronic components, a FPGA, level translation (TTL to -5 to 0V) integrated circuits, and six dc-to-dc power converters are located on the RSN board. Four low power converters and an RFI filter are located on the “A” side of the RSN board, and two 30 W converters are located on the “B” side of the board..

Figure 5.2.2 shows the array block diagram. The array is divided into two sections for redundancy. The link margin is such that in the event of the failure of one side of the array, the link will still be closed.

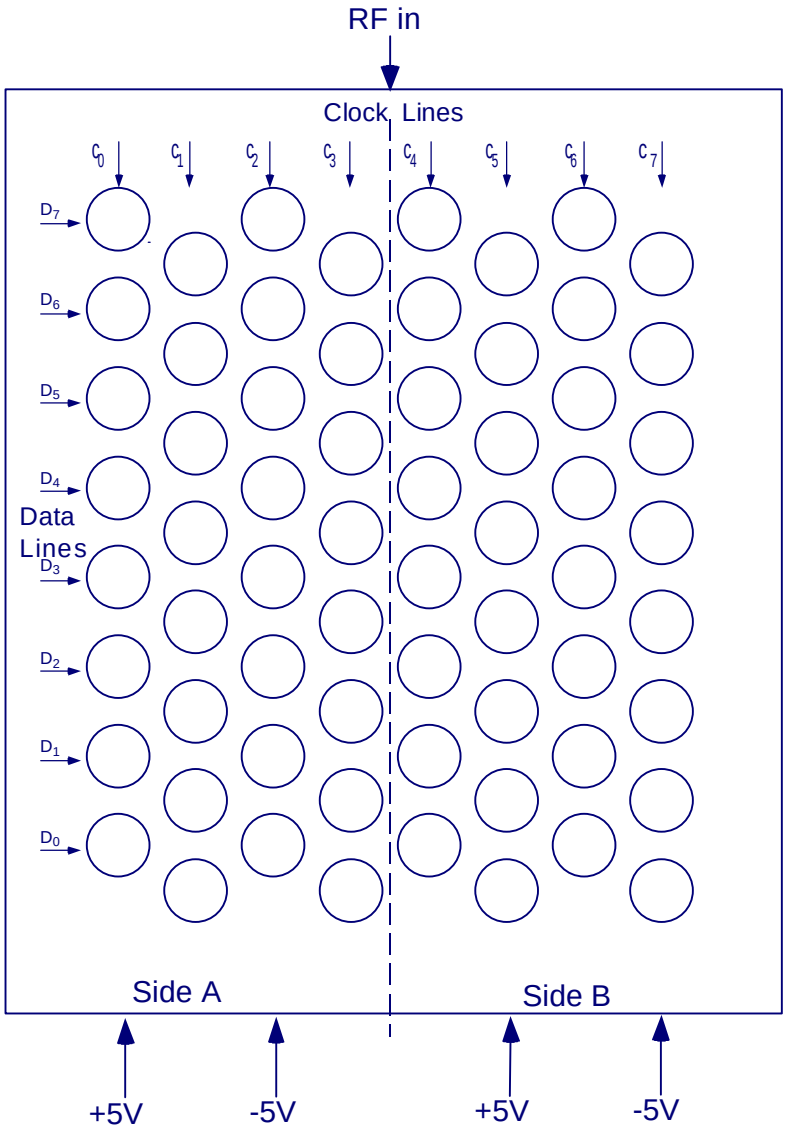


Figure 5.2.2 Array Block Diagram

5.3. RF Interface

Figure 5.3.1.shows the system RF allocations. The excitation is described in the exciter specification Litton Doc. Xxxx. The input interface connector is a female SMA connector mounted at the center of the +Y face of the enclosure. The connector should be tightened to 6 ins-lbs.

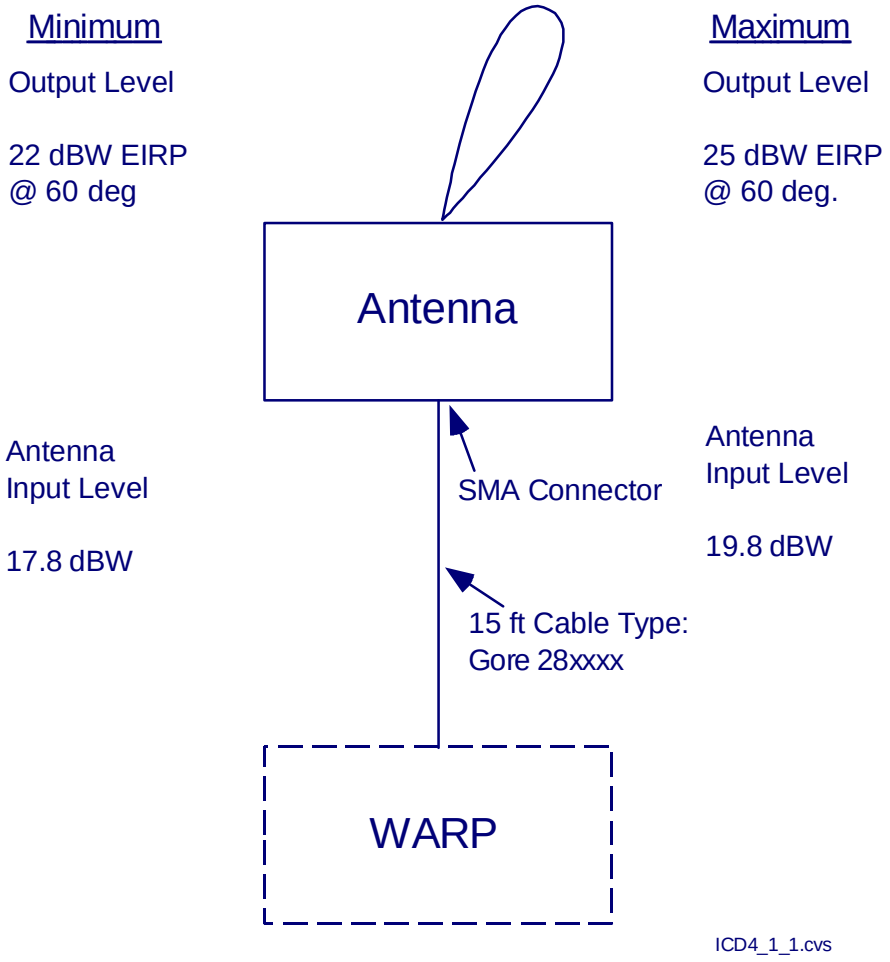


Figure 5.3.1. R.F. Allocations

5.4. DC Power Requirements

The nominal dc power requirement is 44 W with a worst case of 60 W. The antenna will operate over an input voltage range of 21 to 35 V with source impedance, transients, and ripple in accordance with the statement of work. The interface connector is 311P 409-1P and the pin assignment is shown in Table 5.7.2

5.5. Communications Interface

Command, pointing, and telemetry information if transmitted over a dual 1773 bus. The protocols are described in RSN ICD Document No. AM149-0050(155).

5.6. Cabling Interface

The antenna cabling interface is described in the cable harness ICD Swales document No. xxxx

5.7. EMI/RFI

The antenna will satisfy conducted and radiated emission and conducted and radiated susceptibility requirements as specified in the SOW.

5.8. List of Connectors

The antenna external interfaces are implemented with the connectors listed in Table 5.7.1. Connector pin outs are listed in Tables 5.7.2 - 5.7.4.

Table 5.7.1 Antenna Connectors

Connector Number	Connector Type	Pins Used	Description
J1	SMA	-	RF Excitation Input
J2	FC	Fiber	1773 Bus A Input
J3	FC	Fiber	1773 Bus A Output
J4	FC	Fiber	1773 Bus B Input
J5	FC	Fiber	1773 Bus B Output
J6	311-P409-1PB-15 9-Pin D-Type Male	1,5,6,9	28V Input Power
J7	311-P407-3S-B-15 44-Pin D-Type Female	TBD	Service Connector
J8	Female TBD	TBD	Test Connector

Table 5.7.2 Connector J6 Pin-Outs

Pin Number	Signal	Description
1	28V in A	Switched +28 V Power from LVPC
5	28V Return A	28 V Power Return
6	28V in B	Switched +28 V Power from LVPC
9	28V Return B	28 V Power Return

Table 5.7.3 Connector J7 Pin-Outs

	TBD	

Table 5.7.4 Connector J8 Pin-Outs

	TBD	

6. SOFTWARE INTERFACE

The software requirements are described in the Software Specification Document No XPAA-093

7. VALIDATION INTERFACE

7.1. List of Validation Functions

On orbit validation functions are described in the SOW. Housekeeping parameters recorded are voltages and currents supplied by each dc-to-dc converter, and the temperatures of the array baseplate and the ESN lid. Computation of the correct phases for a given θ and ϕ is verified by recording the 64 4-bit phase values transmitted to the 8 x 8 array together with the values of θ and ϕ received from the ACU.

7.2. Implementation of Validation Functions

7.2.1. Array Voltages

The +5V and -5V voltages supplied to each side antenna array are obtained by measuring the voltage at the array side of the resistor in series with dc to dc converter as shown in Figure 7.2.1

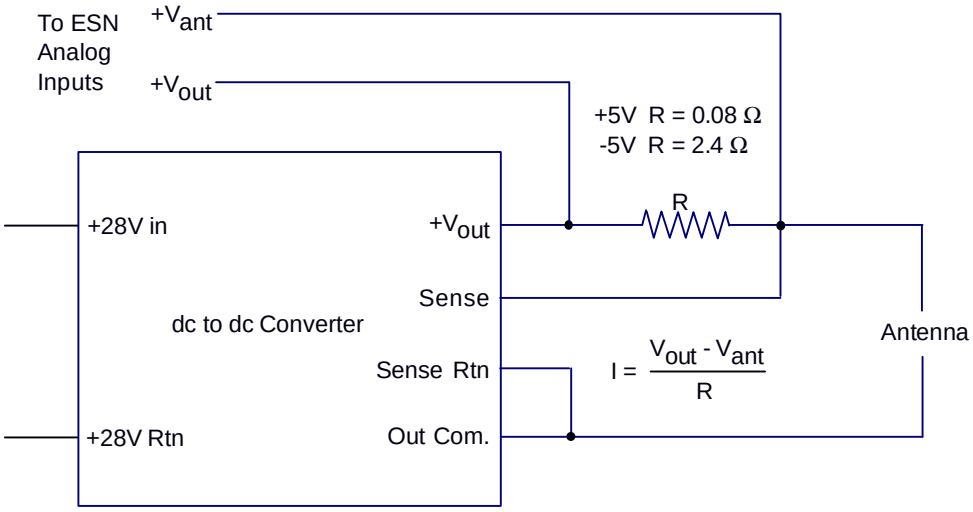


Figure 7.2.1 Antenna Power Supply Voltage Current Measurement Network

7.2.2. Array Currents.

The +5V and -5V currents supplied to each side antenna array are obtained as shown in Figure 7.2.1 by measuring the voltage drop across a resistor in series with the dc to dc converter and the antenna. The series resistors are chosen to provide a 2% precision current measurement assuming 0V to +10V, and +10V to -10V analog voltage ranges for the +5V and -5V lines respectively, and 12-bit A to D conversion.

7.2.3. Temperature Measurements

The temperatures of the center of the array pressure plate and the ESN lid will be measured using thermistors as shown in Figure 7.2.3.

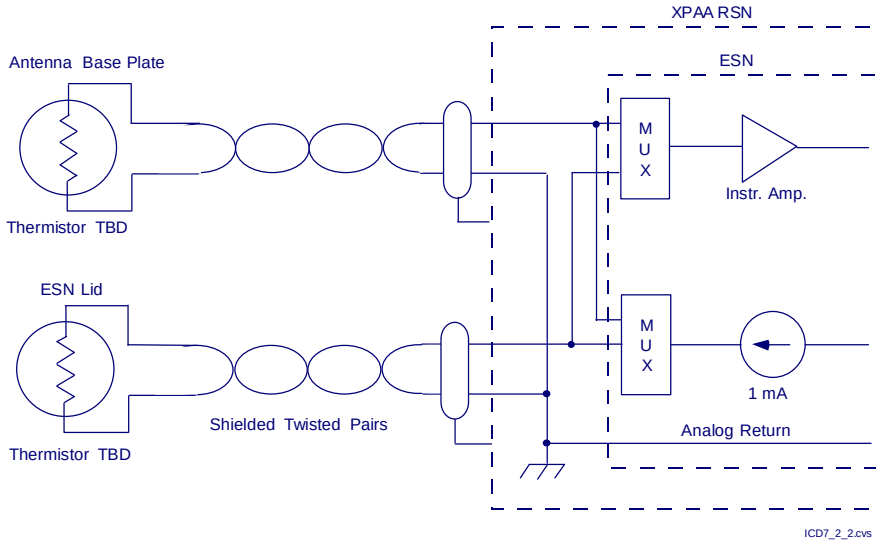


Figure 7.2.3 Temperature Measurement Interface

7.2.4. Phase Bit Verification

The contents of the memory array containing the 64 4-bit phase values (256 bits) will be retrieved and telemetered together with the commanded pointing angles. Further information will be given in the internal software description.

7.3. Ranges of Validation Functions

The expected values and acceptable ranges of the measured parameters are given in Table 7.3. The expected values are preliminary and will be finalized after final integration and testing has been performed. Possible failure modes that will be detected are also given.

Table 7.3 Measured Parameter Values and Ranges

Parameter	Expected Value	Acceptable Range	Failure Mode Identified
+5V Antenna Side A	5.0 V	+/- 0.1 V	Power supply/catastrophic hardware failure
+5V Antenna Side B	5.0 V	+/- 0.1 V	Power supply/catastrophic hardware failure
-5V Antenna Side A	-5.0 V	+/- 0.1 V	Power supply/catastrophic module failure
-5V Antenna Side B	-5.0V	+/- 0.1 V	Power supply/catastrophic module failure
Pos. Current Side A	3.0 to 3.9 A*	+/- 0.3 A^{+}	Module failure
Pos. Current Side B	3.0 to 3.9 A*	+/- 0.3 A^{+}	Module failure
Neg. Current Side A	-90 to -130 mA*	+/- 10 mA^{+}	Module failure, SEL
Neg. Current Side B	-90 to -130 mA*	+/- 10 mA^{+}	Module failure, SEL
Pressure Plate Temp.	10^{o}C above cold plate*	+2^{o}C > expected T	Module failure
ESN Lid Temp.	TBD	TBD	TBD
Phase Bit Array	Precalculated values	No variation	RSN failure, software error

Notes

* =Nominal Values. Final values determined after integration and testing

$^{+}$ = Will depend upon array temperature

SEL = Single Event Latch-up

7.4. Telemetry Frequency

Housekeeping parameters are measured continuously including during antenna non-operating periods. Housekeeping data and phase values are telemetered to the spacecraft C&DH system every 8 seconds and telemetered to ground upon command.

Date: Fri, 23 Jan 1998 13:11:58 -0500 (Eastern Standard Time)
From: Administrator@hst-nic.hst.nasa.gov
Reply-to: (Mark Perry/Swales)
Subject: CCR:0004 - DUE: 01/19/98   ROUTINE Level-2 Mark Perry/Swale WWW-COMMENTS

USER :   (Mark Perry/Swales) sent the following comments on :

Date: 01/23/1998
CCR Number: 0004
Sponsor: K. Perko/NMP-XPAA Lead
Due Date: 01/19/98

CCR Title: BASELINE EO-1 X-BAND PHASED ARRAY ANTENNA SYSTEM ICD-047

Remote host: 198.118.115.46 Email Address:

APPROVAL STATUS: APPROVED WITH COMMENTS
Note: Hard Copy Marked Up Graphics Mailed Separately

COMMENTS:

Summary:

The interface Control Document for the New Millennium Project X-Band Phased Array Antenna (XPAA) provides a definition of all functional, physical, and electrical characteristics of the XPAA that impact the Earth Observer-1 (EO-1) spacecraft on which it will be installed. The interface definition in the ICD is designed to ensure that equipment and software delivered by The Boeing Company will operate properly when installed on the EO-1 spacecraft, will meet the requirements for which it was designed, and will not adversely affect any aspect of the EO-1 spacecraft operations.

TABLE OF CONTENTS

	Page
1. GENERAL..	6
1.1 Scope and Purpose	6
1.2 Antenna Subsystem Overview	6
1.3 Applicable Documents	6
2. SYSTEM INTERCONNECT DIAGRAM	8
3. MECHANICAL INTERFACE	9
3.1 General	9
3.2 Antenna Envelope	9
3.3 Antenna Footprint and Fastener Requirements	9
3.4 Antenna Mounting Requirements	10
3.5 Antenna Mass and Center of Mass	10
4. THERMAL INTERFACE	11
5. ELECTRICAL INTERFACE	12
5.1. General	12
5.2. Electrical Block Diagrams 12	
5.3. RF Interface	13
5.4. DC Power Requirements	14
5.5. Communications Interface	14
5.6. Cabling interface	15
5.7. EMI/RFI	15
5.8. List of Connectors	15
6. SOFTWARE INTERFACE. ..a..,	17
7. VALIDATION INTERFACE	18
7.1 List of Validation Functions	18
7.2 Implementation of Validation Functions	18
7.2.1. Array Voltages	18
7.2.2. Array Currents	18
7.2.3. Temperature Measurements	19
7.2.4. Phase Bit Verification	19
7.3 Range of Validation Functions	19
7.4 Telemetry Frequency	20
8.0 DELIVERABLES	

ACRONYMS AND ABREVIATIONS

ASIC	Application Specific Integrated Circuit
CMOS	Complementary Metal Oxide Semiconductor
DC	Direct Current
D&SG	Defense & Space Group (Boeing)
COTS	Commercial Off-The-Shelf
EO-1 S/C	Earth Observer-1 Spacecraft ORBITER
EIRP	Effective Isotropically Radiated Power
ESN	Essential Services Node
ICD	Interface Control Document
LVPC	Low Voltage Power Supply
MCM	Multi-Chip Module
MMIC	Monolithic Microwave Integrated Circuit
NASA	National Aeronautics and Space Administration
NMP	New Millennium Project
RF	Radio Frequency
RSN	Remote Services Node
s o w	Statement of Work
s s o	Space Systems Operation (Litton Amecom)
V	Volts
XPAA	X-Band Phased Array Antenna
W A R P	Wideband Advanced Recorder Processor

FPGA
PSE
TTL
UART
RFI

1. GENERAL

This ICD contains data and drawings required to define the interface characteristics of the X-Band Phased Array Antenna System that will be mechanically, functionally and electrically integrated with the Earth Observer-1 Spacecraft.

ORBITER

1.1. Scope and Purpose

The ICD will contain all software, hardware (mechanical), thermal, electrical power, RF signal, logic or control signal, telemetry signal, data signal and operational interfaces of the XPAA with the EO-1 spacecraft. Included are the ESN and RSN components.

1.2. Antenna Subsystem Overview

The X-Band phased array antenna comprises 64 active radiating elements each with an independent phase controller and power amplifier allowing electronic steering of the antenna beam. Element phases are calculated to point the beam at the commanded elevation and azimuth by an RSN provided by Litton Amecom. Telemetry and commands are transmitted to the antenna over a dual MIL-STD 1773 fiber optic data bus, and 8.225 GHz RF excitation is supplied by the WARP via a coaxial cable. The data rate is 105Mbps.

The advantage of an electronically steered antenna for small satellite applications, where platform stability is important, is that no reaction torque compensation is needed during a communications pass allowing the simultaneous acquisition of precision optical data.

1.3. Applicable Documents

a. **NASA Document 737-EO1-RSD-XPAA**, "Performance Specification and Design Requirements for the New Millennium Program Earth Observer-l, X-Band Phased Array Antenna", released April 1, 1997

ORBITER

b. **NASA Document 737-EO1-SOW-XPAA**, "Statement of Work for the New Millennium Program Earth ~~Observer-~~1, X-Band Phased Array Antenna", released April 4, 1997

ORBITER

c. **Swales Aerospace, Inc. Internal Memo, "EO-1 X-Band Antenna Environmental Criteria"**, George Hinshelwood to Mike Cully, EO-1 Project Manager/Swales Aerospace, released March 24, 1997, transmitted to Gary Miller, X-Band/Mechanical Lead/Boeing Company

d. **MIL-STD-461C,** Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference (Notice 1)

e. **MIL-STD-462,** Measurement of Electromagnetic Interference Characteristics

f. **MIL-STD-1773B,** Fiber Optics Mechanization of an Aircraft Internal Time-Division Command/Response Multiplex **Data Bus**

g. **NASA Document ICD-735-2827,** "Essential Services Node hardware Specification (Revision 2.0)"

h. **Litton Drawing** No. **184622,** "Chassis Assembly, LWH-14-.050"

i. **Litton Document ICD-xxx-xxx,** "X-Band Exciter to Memory Interface Control Card"

j. **Swales Document** XXX-XXX, "Cable ICD"

K. AM-149-0020(155) SYSTEM LEVEL ELECTRICAL REQUIREMENTS, EO-1

C. SAI-SPEC-158 EO-1 VERIFICATION PLAN AND ENVIRONMENTAL SPECIFICATION.

L. 1773 ICD AM149-0050(155)

M. S/W SPEC XPAA-093

3. MECHANICAL INTERFACE

3.1. General

The antenna enclosure is a two level structure. The 64 radiating elements and the high wattage dc to dc converters for the antenna 5V power are located on the upper level, and an RSN controller board is located on the lower level. The lower level of the enclosure is geometrically identical to one slot of the Litton Chassis (Litton drawing No. 184622) permitting the generic RSN board to be accommodated without any mechanical change to the basic RSN.

3.2. Antenna Envelope

Figure 3.2.1 shows the physical envelope of the antenna. The RF excitation input, the service connector, and the fiber optic connectors are located on the positive Y direction face, and the test connector on the negative Y direction face.

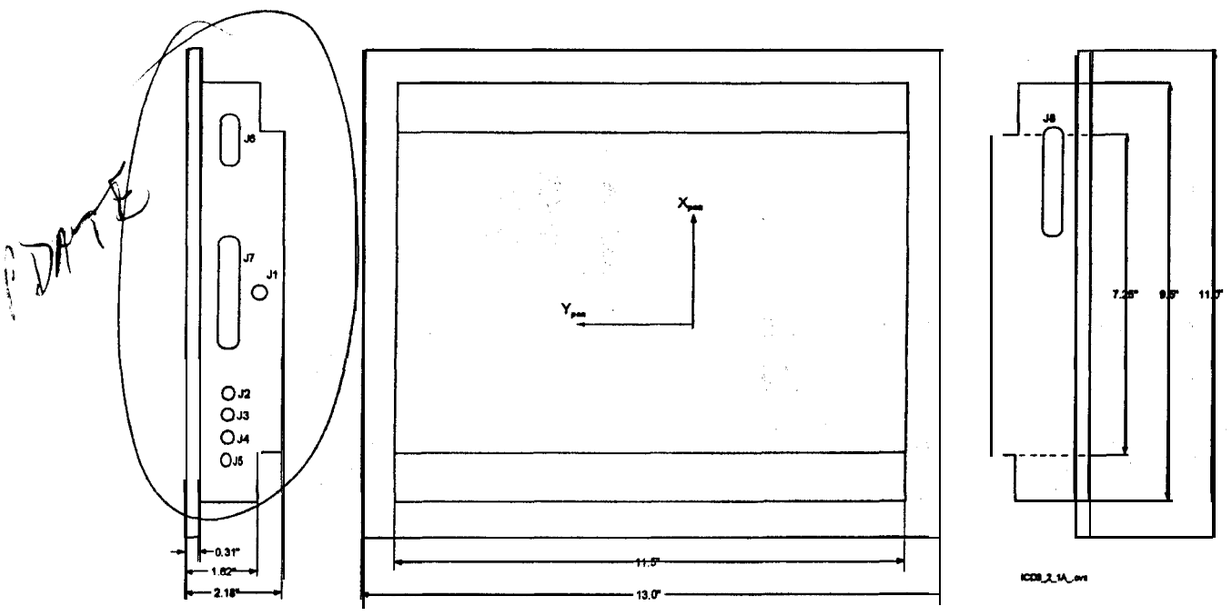


Figure 3.2.1 Physical Envelope of the Antenna

3.3. Antenna Footprint and Fastener Requirements

Figure 3.3.1 shows the mechanical footprint of the antenna. The antenna is secured to the mounting plate by 8 NES 1578 ¼-28 threaded fasteners.

IS THIS CORRECT?

2. SYSTEM INTERFACE DIAGRAM

An interconnect diagram is provided to show the system level interconnects for RF excitation, fiber optic control and telemetry signals, and DC power. A service connector for software loading, and a test connector for testing during integration are also shown. Electrical and signal characteristics, and cabling are further defined in Section 5

Figure 2.1 shows the system interface connections between the antenna and the WARP, the fiber optic star coupler, and the 28 V power supply.

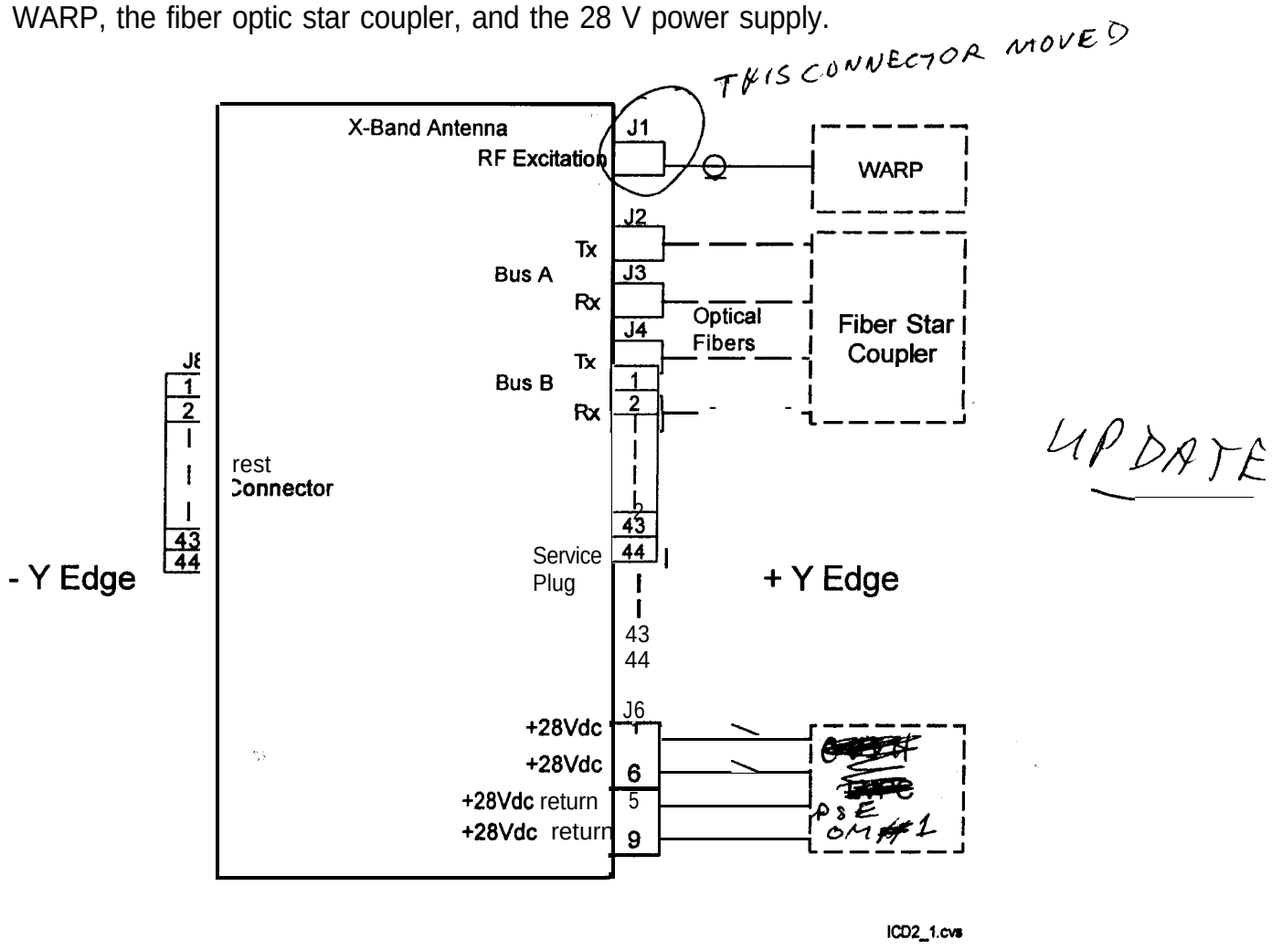


Figure 2.1 System Interface Diagram

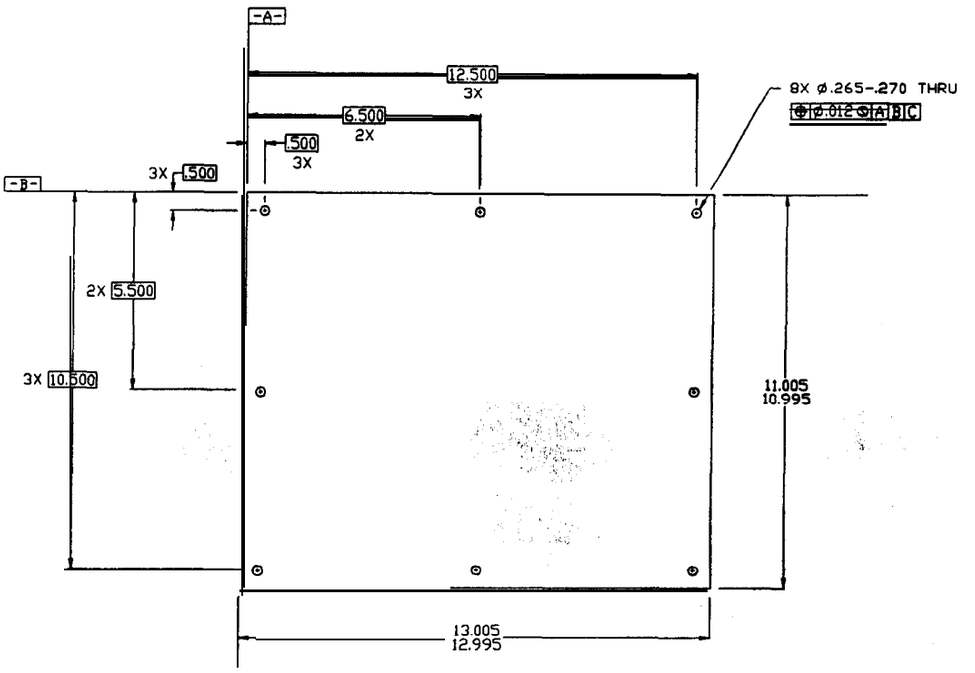


Figure 3.3.7 Antenna Footprint

REPLACED WITH ECCOBOND 57C

3.4. Antenna ~~Mounting~~ Requirements

A sheet of xxx Co-Therm should be placed between the antenna and the mounting plate, and the ~~¼-28 fasteners~~ torqued to 91 ins-lbs.

TOO #164

3.5. Antenna Mass ~~and Center of Mass~~

~~TBD~~

The antenna shall not weigh more than 5.5 kg.

*THE X-BAND ANTENNA WILL NOT BE TRANSMITTING FOR MORE THAN 10 MINUTES PER ORBIT, WHEN NOT TRANSMITING, THE ANTENNA WILL DISAPATE 3405 WATTS.

4. THERMAL INTERFACE

Power dissipated by the antenna will range from 40 to 56 W depending upon the final MMIC configuration. ~~Radiated heat input or loss during operation and transient behavior are TBD.~~ *

The antenna shall be thermally coupled to the X-BAND INTERFACE PLATE. The nadir-facing surface shall be white. The spacecraft will supply MLI ~~and~~ heaters, or both to maintain the temperature OF THE I/F PLATE within the limits described in Table 4.1.

LIMITS	OPERATING	NON-OPERATING
MIN		
MAX		

} FILL IN XPAA REQUIREMEN

TABLE 4.1

Figure 4.1 shows the thermal architecture of the X-Band antenna, ~~including the radar~~.

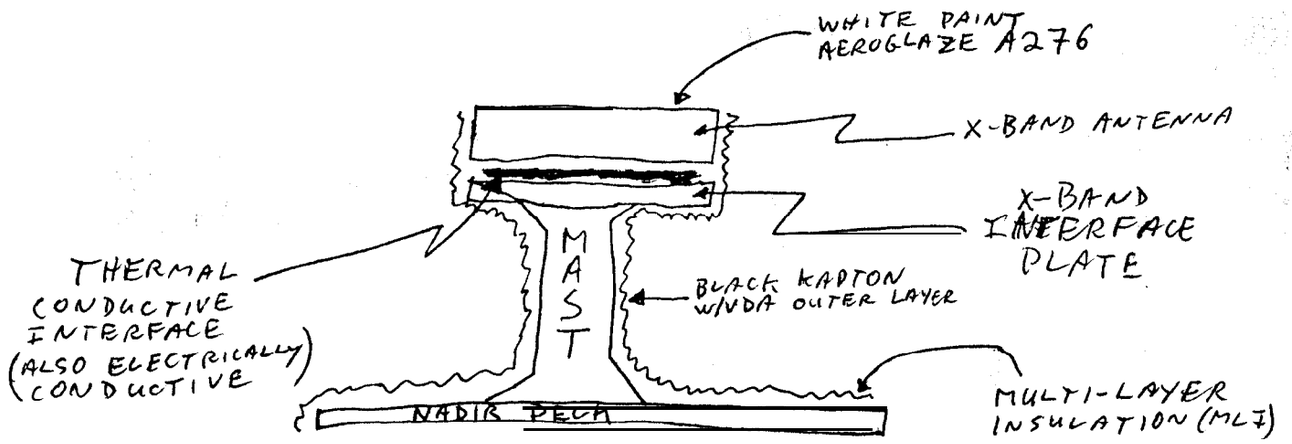


FIGURE 4.1

Figure 5.2.2 shows the array block diagram. The array is divided into two sections for redundancy. The link margin is such that in the event of the failure of one side of the array, the link will still be closed.

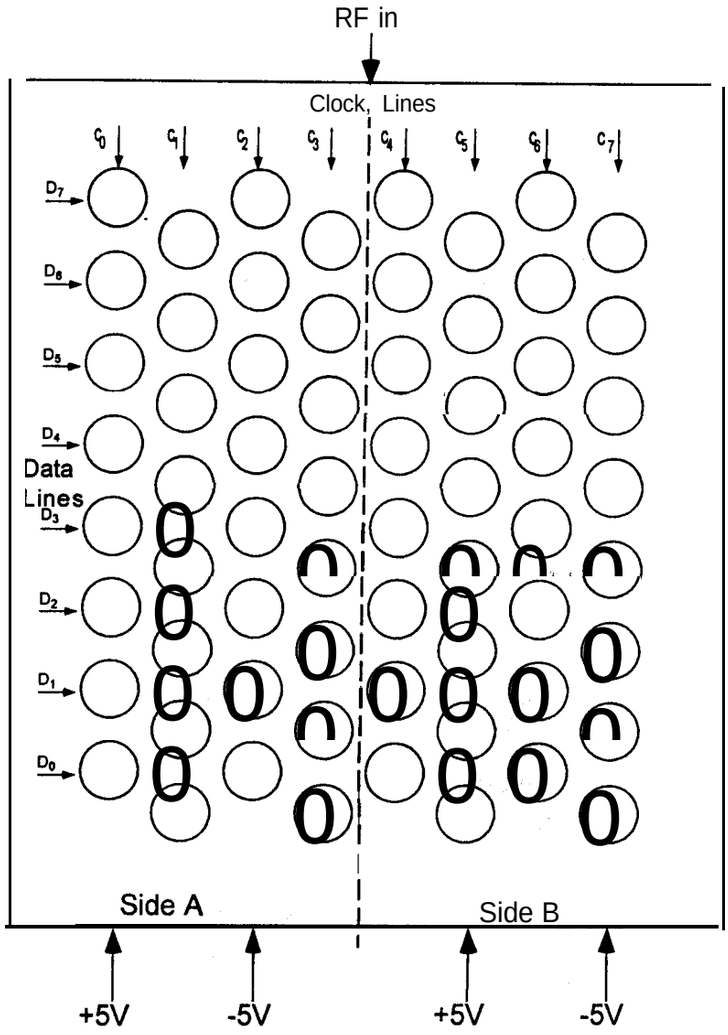


Figure 5.2.2 Array Block Diagram

5.3. RF Interface

Figure 53.1 .shows the system RF allocations. The excitation is described in the exciter specification Litton Doc. Xxxx. The input interface connector is a female SMA connector mounted at the center of the +Y face of the enclosure. The connector should be tightened to 6 ins-lbs.

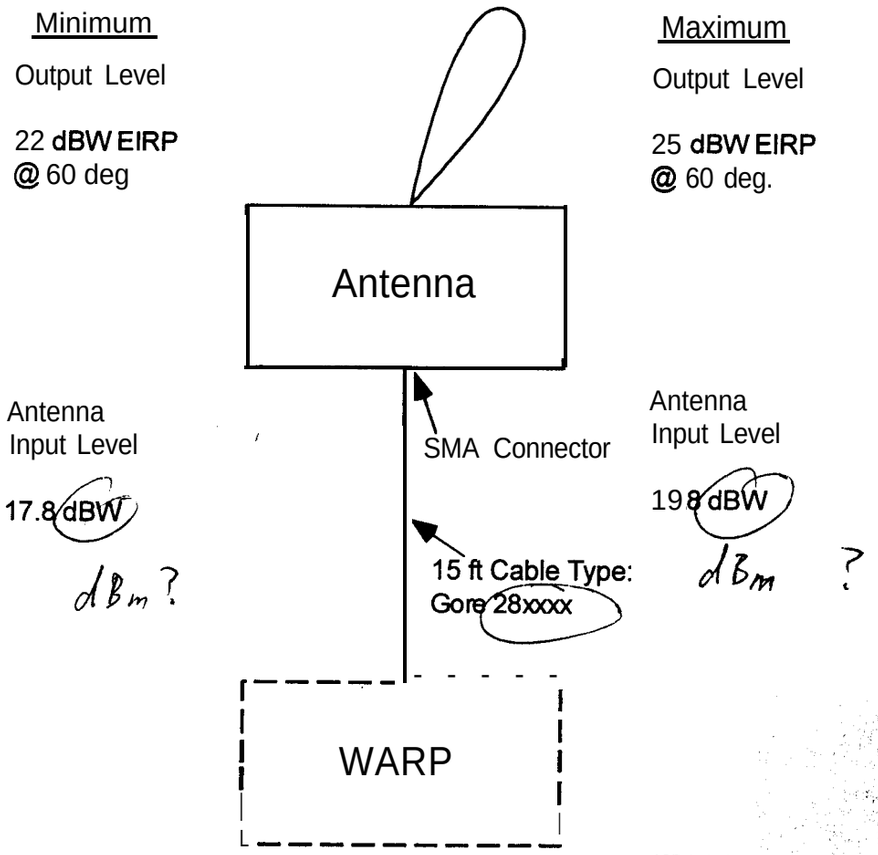


Figure 53.1. R.F. Allocations

5.4. DC Power Requirements

The nominal dc power requirement is 44 Wwith a worst case of 60 W. The antenna will operate over an input voltage range of 21 to 35 V with source impedance, transients, and ripple in accordance with the statement of work. The interface connector is 311 P 409-I P and the pin assignment is shown in Table 5.7.2

5.5. Communications Interface

Command, pointing, and telemetry information if transmitted over a dual 1773 bus. The protocols are described in RSN ICD Document No. AM149-0050(155).

5.6. Cabling Interface

The antenna cabling interface is described in the cable harness ICD Swales document No. xxxx

5.7. EMI/RFI

The antenna will satisfy conducted and radiated emission and conducted and radiated susceptibility requirements as specified in the SOW.

5.8. List of Connectors

The antenna external interfaces are implemented with the connectors listed in Table 5.7.1. Connector pin outs are listed in Tables 5.7.2 - 5.7.4.

Table 5.7.1 Antenna Connectors

Connector Number	Connector Type	Pins Used	Description
JI	SMA	-	RF Excitation Input
J2	FC	Fiber	1773 Bus A Input
J3	FC	Fiber	1773 Bus A Output
J4	FC	Fiber	1773 Bus B Input
J5	FC	Fiber	1773 Bus B Output
J6	31 1-P409-1 PB-15 9-Pin D-Type Male	1,5,6,9	28V Input Power
J7	31 1-P407-3S-B-15 44-Pin D-Type Female	TBD	Service Connector
J8	Female TBD	TBD	Test Connector

Table 5.7.2 Connector J6 Pin-Outs

Pin Number	Signal	Description
1	28V in A	Switched +28 V Power from LVPC
5	28V Return A	28 V Power Return
6	28V in B	Switched +28 V Power from LVPC
9	28V Return B	28 V Power Return

Table 5.7.3 Connector J7 Pin-Outs

	TBD	

Table 5.7.4 Connector J8 Pin-Outs

	TBD	

ASSUMING THAT THESE CONNECTORS WILL BE USED DURING S/C I+T, NEED PIN OUTS.

Table 7.3 Measured Parameter Values and Ranges

Parameter	Expected Value	Acceptable Range	Failure Mode Identified
+5V Antenna Side A	5.0 v	+/- 0.1 v	Power supply/catastrophic hardware failure
+5V Antenna Side B	5.0 v	+/- 0.1 v	Power supply/catastrophic hardware failure
-5V Antenna Side A	-5.0 v	+/- 0.1 V	Power supply/catastrophic module failure
-5V Antenna Side B	-5.ov	+/- 0.1 v	Power supply/catastrophic module failure
Pos. Current Side A	3.0 to 3.9 A*	+/- 0.3 A+	Module failure
Pos. Current Side B	3.0 to 3.9 A*	+/- 0.3 A+	Module failure
Neg. Current Side A	-90 to -130 mA*	+/- 10 mA+	Module failure, SEL
Nea. Current Side B	-90 to -130 mA*	+/- 10 mA+	Module failure, SEL
Pressure Plate Temp.	10°C above cold plate*	+2°C > expected T	Module failure
ESN Lid Temp.	TBD	TBD	TBD
Phase Bit Arrav	Precalculated values	No variation	RSN failure, software error

Notes

* =Nominal Values. Final values determined after integration and testing
\+ = Will depend upon array temperature
SEL = Single Event Latch-up

7.4. Telemetry Frequency

Housekeeping parameters are measured continuously including during antenna non-operating periods. Housekeeping data and phase values are telemetered to the spacecraft C&DH system every8 seconds and telemetered to ground upon command.

8.0 DELIVERABLES

1. PHASED ARRAY ANTENNA
2. TEST RESULTS/REPORTS
3. TEST PROCEDURES FOR S/C I&T
4. TEST H/W AND S/W, IF NECESSARY (FOR USING SERVICE CONNECTOR & TEST PLUG

ALL DUE BY 15 JUNE 1998

Date: Tue, 27 Jan 1998 16:20:24 -0500 (Eastern Standard Time)
From: Administrator@hst-nic.hst.nasa.gov
Reply-to: (Joe Howard)
Subject: CCR:0004 - DUE: 01/19/98   ROUTINE Level-2 Joe Howar WWW-COMMENTS

USER :   (Joe Howard) sent the following comments on :

Date: 01/27/1998
CCR Number: 0004
Sponsor: K. Perko/NMP-XPAA Lead
Due Date: 01/19/98

CCR Title: BASELINE EO-1 X-BAND PHASED ARRAY ANTENNA SYSTEM ICD-047

Remote host: 198.118.115.46 Email Address:

APPROVAL STATUS: APPROVED WITH COMMENTS
Note:

COMMENTS: 1. Fig 5.3.1 Antenna input power is given in the figure as 17.8dBW
presumably this should be 17.8dBm same for 19.8 input power number.

2. There is no information about the software packet interface. The
document described in XPAA-093 should be in the list of referenced
documents

3. There is no definition of 1773 power levels.

4. There is no definition of which is the Positive phase direction. ie.
if I send a positive phase command to the phase array which direction does
the beam steer. It is an assumption on my part a positive X phase command
will result in the beam steering in the +ve X direction. ditto Y.

5. Damage level for RF input?

Date: Wed, 28 Jan 1998 10:16:54 -0500 (Eastern Standard Time)
From: Administrator@hst-nic.hst.nasa.gov
Reply-to: (Brian Smith)
Subject: CCR:0004 - DUE: 01/19/98   ROUTIN Level-2 Brian Smit WWW-COMMENTS

USER :   (Brian Smith) sent the following comments on :

Date: 01/28/1998
CCR Number: 0004
Sponsor: K. Perko/NMP-XPAA Lead
Due Date: 01/19/98

CCR Title: BASELINE EO-1 X-BAND PHASED ARRAY ANTENNA SYSTEM ICD-047

Remote host: 128.183.212.183 Email Address: brian.s.smith@gsfc.nasa.gov
---
APPROVAL STATUS: DISAPPROVED
Note:

COMMENTS: Too many unincorporated comments.
Need to resolve these issues before approval